PCB Source Investigation

for the

Development of the Roanoke (Staunton) River TMDL

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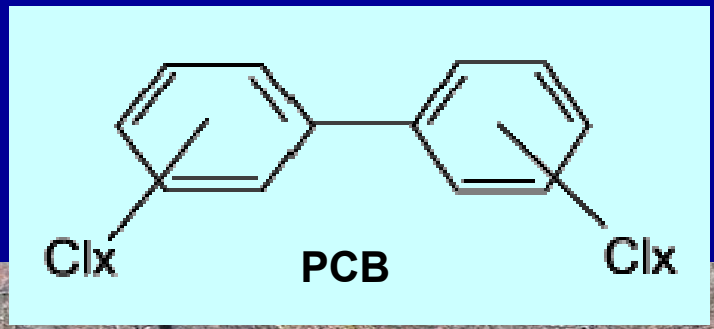
Discussion Overview

- PCB Background
- Monitoring
- PCB Analysis
- Results
- PCB WQC vs. Site Specific Endpoints



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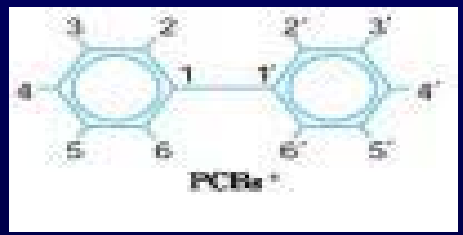
What are PCBs?

- Biphenyl molecule (1-10 chlorine atoms)
- 209 distinct PCB Compounds – "Congeners"
- Total PCB (tPCB) = Summation of 209 Congeners *(Basis for VA WQC)*
- Aroclors – mixture of congeners
  - Aroclor 1248 is 48% chlorine



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PCBs - Background

- Estimated that > 1.5 Billion lbs. manufactured in the U.S. until 1977
- Very stable and heat resistant
- Common uses:
  - Transformers, capacitors, hydraulic fluids, circuit breakers, PVC Products, carbonless copy paper, caulking material, etc.

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PCBs – Current Releases?

- PCBs used many years after banned
- Contaminated sites with active transport
- Dielectric oils considered non PCB < 50 ppm
  - Fish advisories at 0.05 ppm
- Inadvertent production

EPA Method 1668

- Performance based method
  - High Resolution GC/High Resolution MS
- Measures Tot. PCB - Congener-specific basis
  - Detection Level <5 pg/L (or 0.000005 ug/L)
  - Reporting Level < 10 pg/L
  - Levels are relevant to DEQ's WQC (640 pg/L)
- Used for the Delaware/Potomac River TMDLs
- Extensively used for the Roanoke (Staunton) River TMDL

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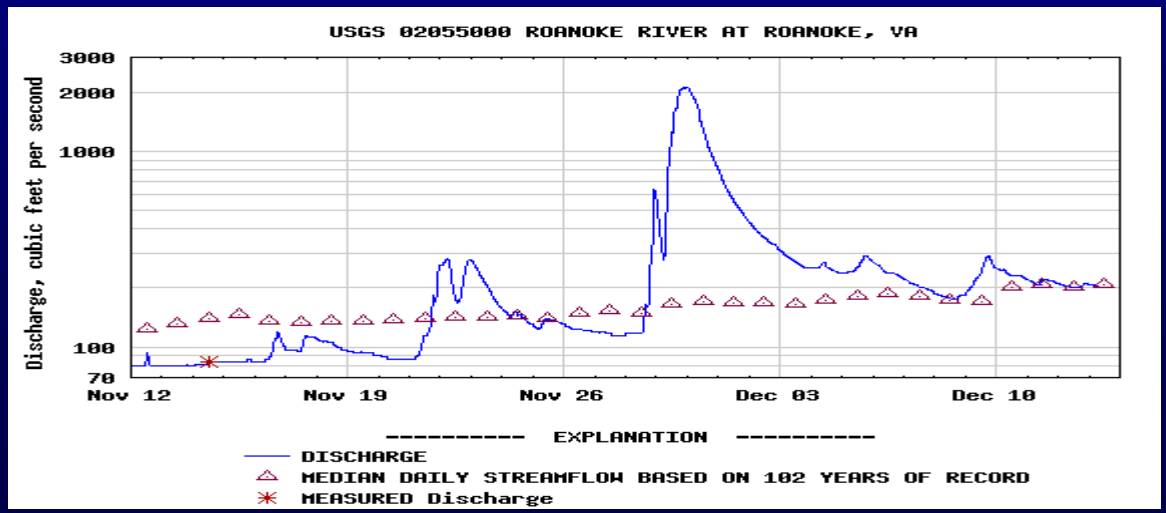
Ambient PCB Monitoring Design

- PCB grab samples collected along with dissolved and total organic carbon and TSS
- Base (low) & high flow condition
- Accounts for event driven PCB loads



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Monitoring Summary

- Round 1
  - Fall 2005
    - SPMDs (deployed 25 and retrieved 21)
    - Grab samples (low and high river flows)
    - Effluent (1 facil. in upper & 3 in lower)
    - Method 1668A used for Analysis
      - Analytical issue – significant correction due to background contamination
    - Results qualitative (??)
    - Revealed/confirmed source areas

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Monitoring Summary

- Round 2
  - Fall 2007-Spring 2008
    - 46 water grab samples (low and high river flows)
    - Effluent (1 facil. in upper and 3 in lower)
    - Sediment (14 sediment/6 sludge)
    - Method 1668A used for Analysis
      - Collected larger volume (water)
        - » Lower Reporting Levels (~5 pg/L on a congener basis)
        - » Background minimized

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Uses for PCB Data

- PCB Source identification
  - Wastewater samples
    - Calculate PCB loadings
  - Ambient samples
    - Homolog groups and congeners help "fingerprint" sources
- Assist with TMDL model calibration & validation
- Used to develop PCB endpoint

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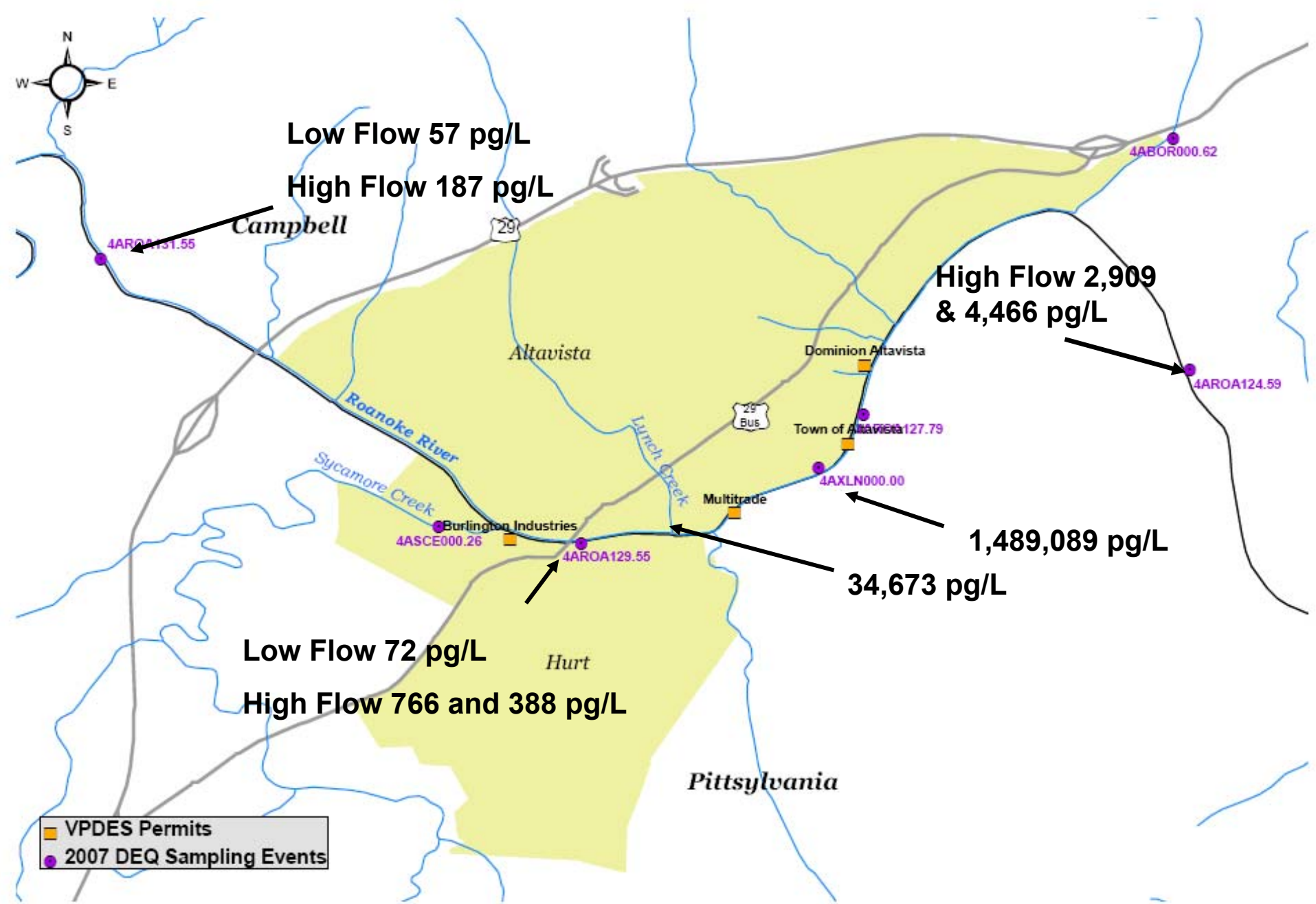
Results

Results

Ambient Location	Sample Date	Flow Condition	tPCB pg/L	Sample Date	Flow Condition	tPCB pg/L
Staunton River						
4AGSE000.20	9/10/07	Low	34	10/26/07	High	343
4ASCE000.26	8/27/07	Low	29		High	
4AROA131.55	8/8/07	Low	57	5/9/08	High	187
4AROA129.55	8/8/07	Low	72	10/26/07	High	766
4AROA129.55		No Data		5/9/08	High	388
4ALYH000.17		No Data		5/20/08	High	34,673
4AXLN000.00		No Data		Dec-07	High	1,489,098
4AROA127.79	8/9/07	Low	148		No Data	
4AROA124.59		No Data		3/10/08	High	2,909
4AROA124.59		No Data		5/9/08	High	4,466
4AROA108.09	9/10/07	Low	1,147		No Data	
4ABOR000.62	8/21/07	Low	115	10/26/07	High	253
4AROA097.76	8/8/07	Low	1,115	3/6/08	High	4,304
4AROA090.50	8/8/07	Low	1,192	10/26/07	High	1,625
4AFRV002.78	9/10/07	Low	18		High	
4AROA067.91	9/10/07	Low	1,336	10/26/07	High	1,307
4ACUB002.21	8/28/07	Low	12	10/26/07	High	13
4AROC001.00	8/28/07	Low	26	10/26/07	High	5
4ABWC001.00		No Data		10/26/07	High	559
4AROA059.12	9/10/07	Low	1,627	10/26/07	High	1,359
4ADFF002.02	8/28/07	Low	4			


Low Flow 57 pg/L
High Flow 187 pg/L
Campbell
4AROA131.55
29
Altavista
4ABOR000.62
High Flow 2,909
& 4,466 pg/L
Dominion Altavista
4AROA124.59
Roanoke River
Lynch Creek
29
Bus
Town of Altavista
127.79
4AXLN000.00
Sycamore Creek
Multitrade
Burlington Industries
4ASCE000.26
4AROA129.55
1,489,089 pg/L
34,673 pg/L
Low Flow 72 pg/L
High Flow 766 and 388 pg/L
Hurt
Pittsylvania
VPDES Permits
2007 DEQ Sampling Events

Ambient Water PCB Results (Altavista Area)

- Town of Altavista located river mile 128
- Tributaries above the town do not appear to be a source (34 pg/L - 313 pg/L)
- Results obtained during elevated flow from an un-named tributary draining an industrial sight where TSCA clean-up occurred
  - PCB concentration = ***1,489,098 pg/L (1.49 ug/L)***

Water Quality Criterion = 640 pg/L
Proposed Endpoint = 150 pg/L

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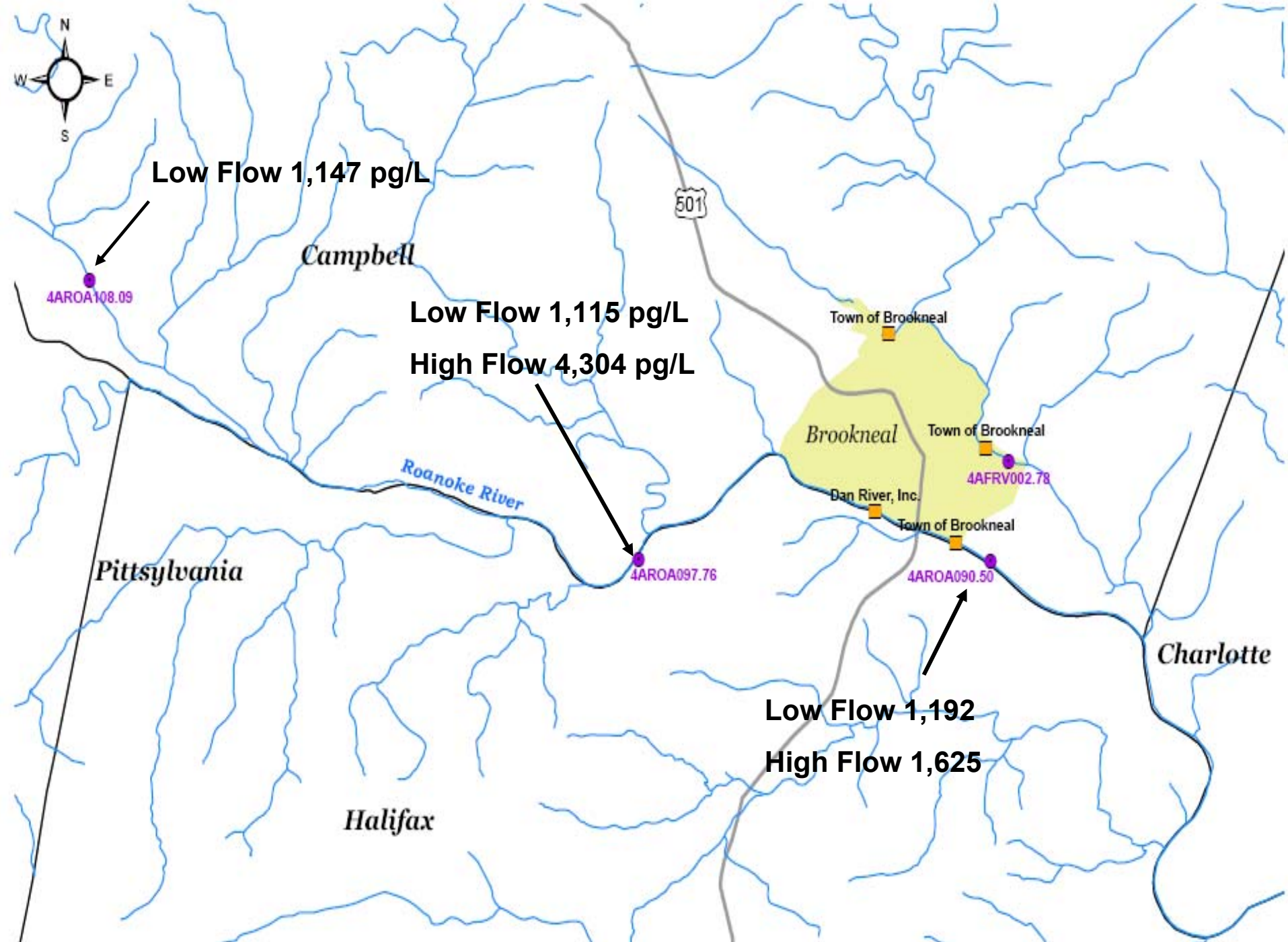
N
W
E
S
Low Flow 1,147 pg/L
Campbell
4AROA108.09
501
Low Flow 1,115 pg/L
High Flow 4,304 pg/L
Town of Brookneal
Brookneal
Town of Brookneal
4AFRV002.78
Roanoke River
Dan River, Inc.
Town of Brookneal
Pittsylvania
4AROA097.76
4AROA090.50
Charlotte
Low Flow 1,192
High Flow 1,625
Halifax

Ambient Water PCB Results (Brookneal Area)

- Loadings from tributaries appear to be low (22 pg/L to 244 pg/L)
- From river mile 108 extending down to river mile 90.50, concentrations range from 1,056 pg/L to 1,312 pg/L during low flow
  - Reflects partitioning of PCBs from sediments
    - Upstream source(s) likely replenishing sediment
- Concentrations at higher flow slightly elevated (1,625 pg/L)
- Congener patterns similar to the un-named trib.

Water Quality Criterion = 640 pg/L
Proposed Endpoint = 150 pg/L

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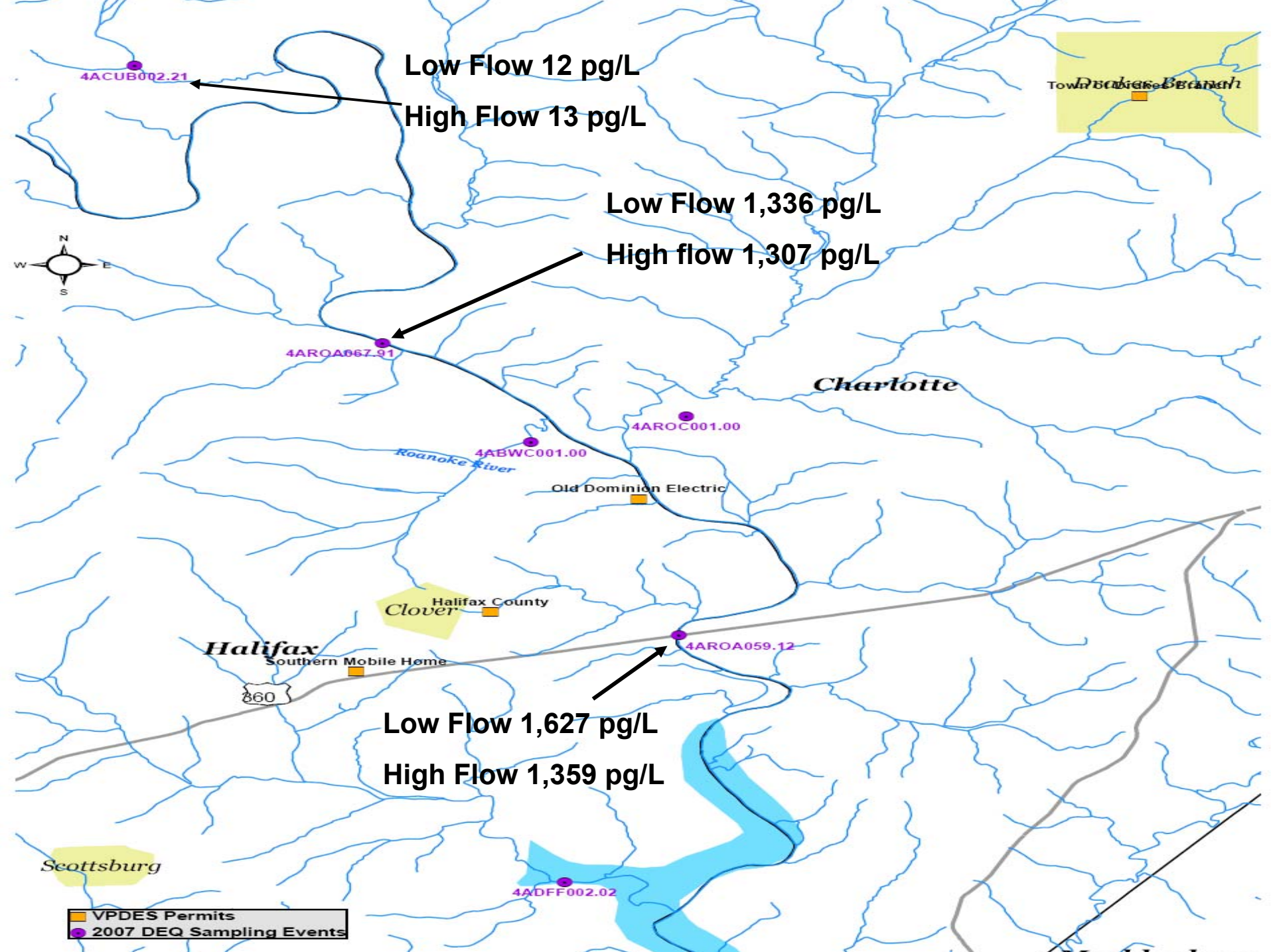
Low Flow 12 pg/L
High Flow 13 pg/L
4ACUB002.21
Low Flow 1,336 pg/L
High flow 1,307 pg/L
4AROA067.91
Charlotte
4AROC001.00
4ABWC001.00
Roanoke River
Old Dominion Electric
Halifax County
Clover
Halifax
Southern Mobile Home
360
4AROA059.12
Low Flow 1,627 pg/L
High Flow 1,359 pg/L
Scottsburg
4ADFF002.02
VPDES Permits
2007 DEQ Sampling Events

Ambient Water PCB Results (Clover Area)

- With the exception of a single tributary (520 pg/L), all other tributaries yielded low PCB levels (4 pg/L to 41 pg/L)
- In the mainstem river from mile 67.91 extending down to river mile 59.12, concentrations averaged 1,013 pg/L with a maximum concentration of 1,525 pg/L
  - Reflects partitioning from sediment to water
    - Upstream source(s) likely replenishing sediment
- Congener patterns similar to the un-named trib.

Water Quality Criterion = 640 pg/L
Proposed Endpoint = 150 pg/L

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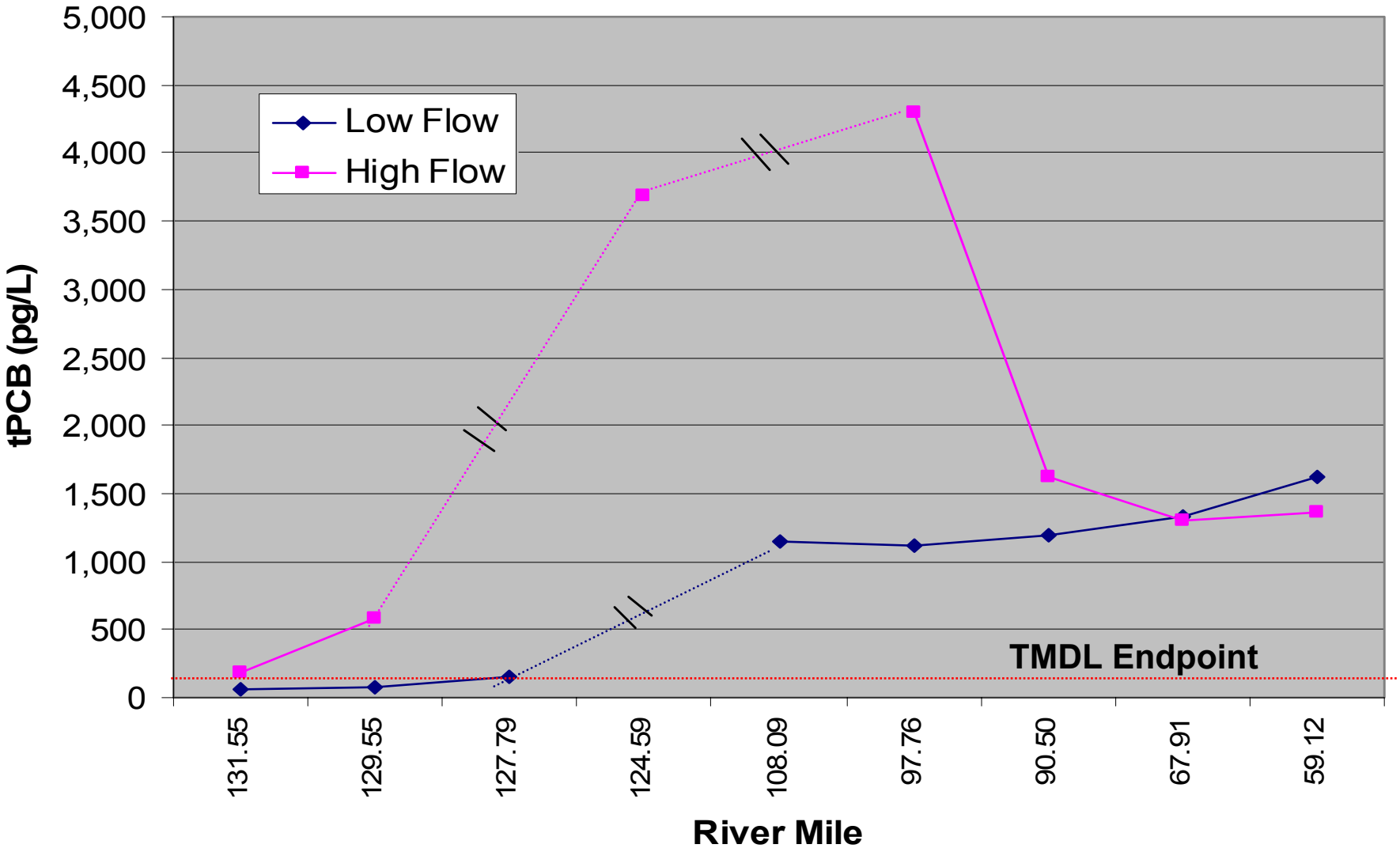
Total PCB in the Roanoke (Staunton) River During Low and High Flow Conditions (Grab Samples)



Staunton River (Effluent) PCB Results

Facility	Sample Date	Total PCB (pg/L) *Blank adj	Comments
Burlington Hurt (DEQ)	January-06	**60,372**	Plant Fully Operational
Burlington Hurt (DEQ)	August-07	**7,222**	Plant Closed - Early August Sample
Burlington Hurt (DEQ)	August-07	2,141	Plant Closed - Late August Sample
Burlington Hurt (Facil)	August-07	**6,888**	Plant Closed
Altavista STP	August-07	**9,998**	
Dan River, Inc	January-06	504	Questionable Sample- volume (Plant is closed)
Clover Power Station (001)	August-07	190	
(009)	August-07	31	

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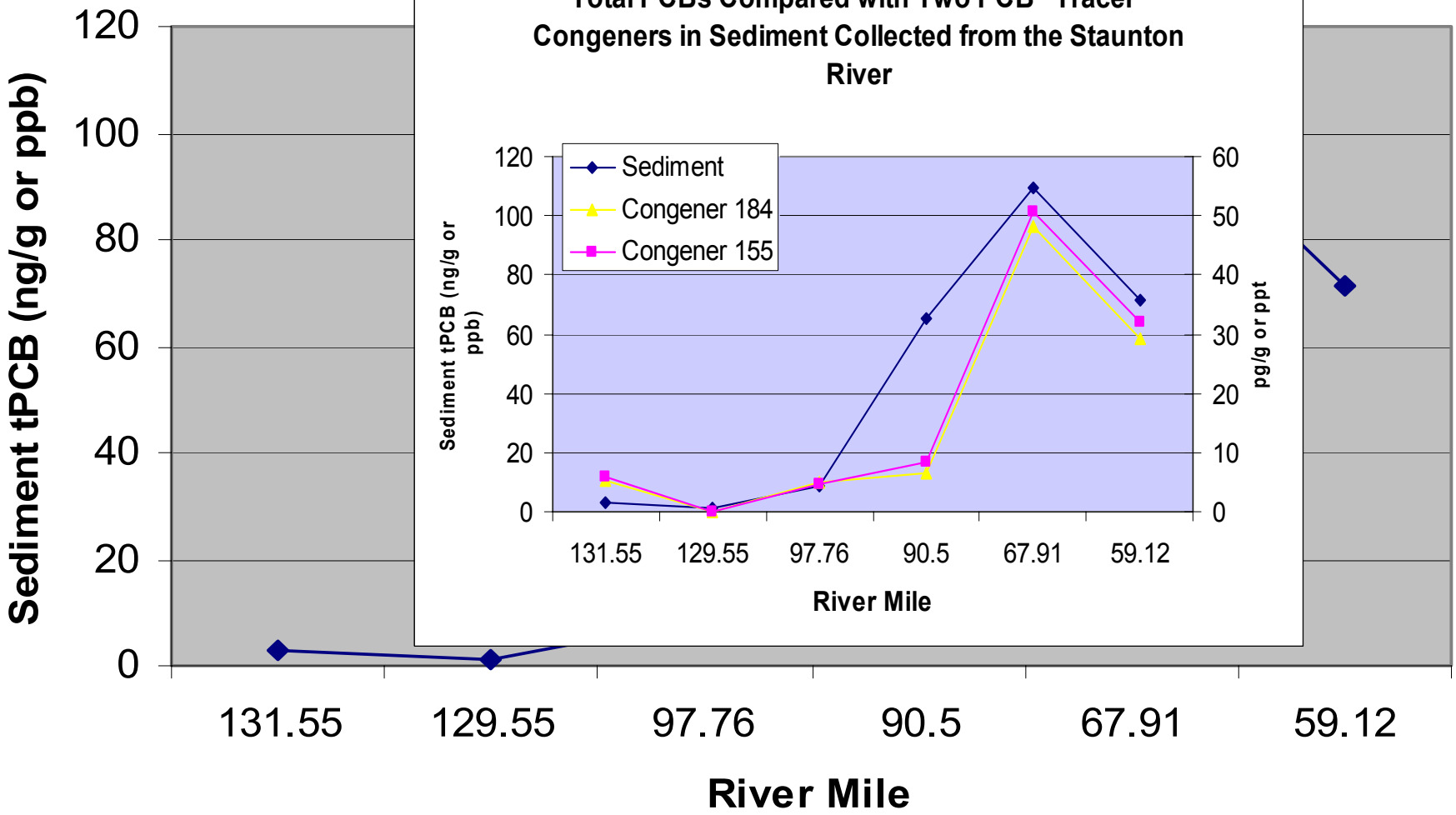
Total PCBs in Sediment Collected from the Staunton River



Sources of PCBs Considered in the TMDL Development

- Point Sources (selected based on DEQ's Pt Source Monitoring Guidance)
  - Major/Minor Municipal and Industrial facilities
  - Industrial Stormwater/General Permits
  - MS4
- Contaminated Sites
- Tributaries
- Non-Regulated Stormwater
- Atmospheric deposition
- Sediment

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Water Quality Criterion vs. Site Specific Endpoint

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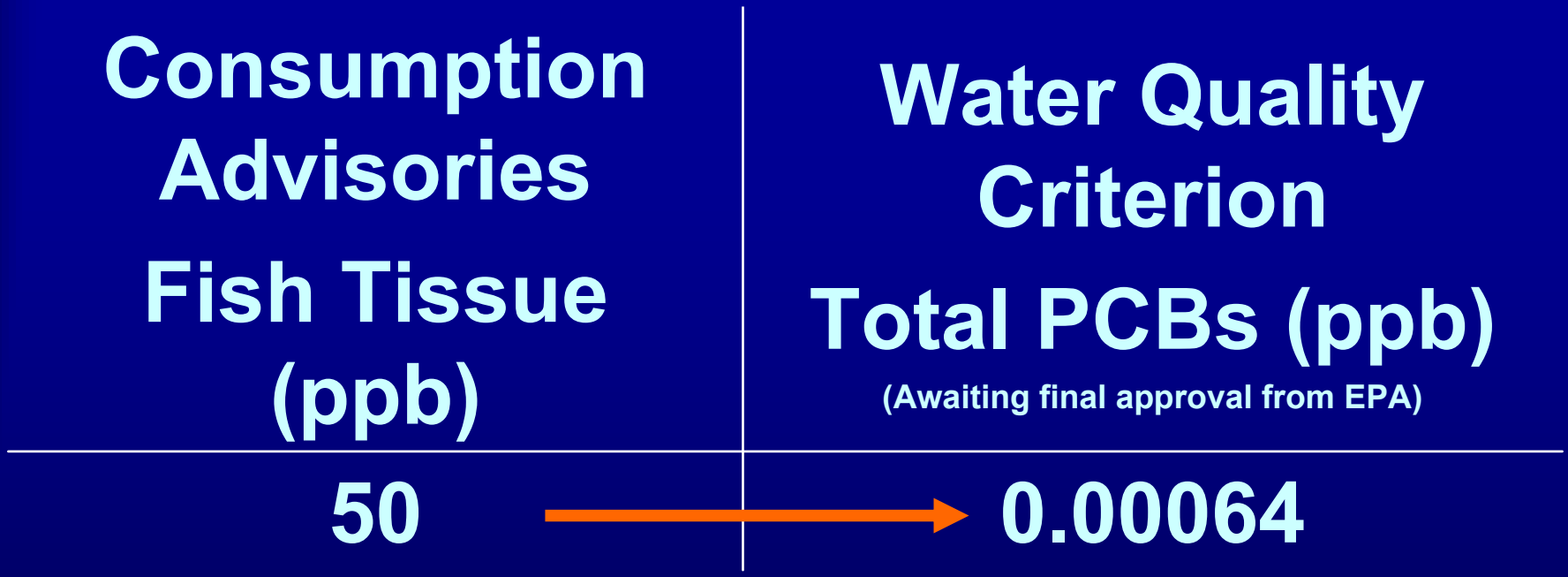
VA Criteria



–WQC represents concentration in water column where accumulation of PCBs in fish should be at a level protective of fish tissue for consumption (humans)

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PCB Exposure Pathways to Fish

- Intake through gills from water column
  - Basis of existing WQC (1980 EPA guidelines)
- Ingestion of prey
  - Biomagnification
- Ingestion of contaminated sediment
  - Indirect uptake from foraging
- Exposure through skin from contaminated sediment (e.g. catfish)

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Site Specific PCB Endpoint

- TMDL Studies have shown criterion met instream but fish remain contaminated
- Supports development of a Site Specific Endpoint (BAF approach; 2000 EPA guidelines)
  - Accounts for localized conditions that affect bioaccumulation
    - Utilizes site specific water and fish data
    - Accounts for trophic transfer
  - Example: Potomac R. water endpoint (64 pg/L)
- Applies to TMDL development

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Site Specific Endpoints

- Upper Roanoke River
  - Based on Carp (species included on VDH fish consumption advisory list)
    - Sample size adequate (n = 20)
  - Target water concentration = **360 pg/L**
- Lower Roanoke River
  - Based on Striped Bass (species included on VDH fish consumption advisory list)
    - Sample size more than adequate (n = 62)
  - Target water concentration = **150 pg/L**

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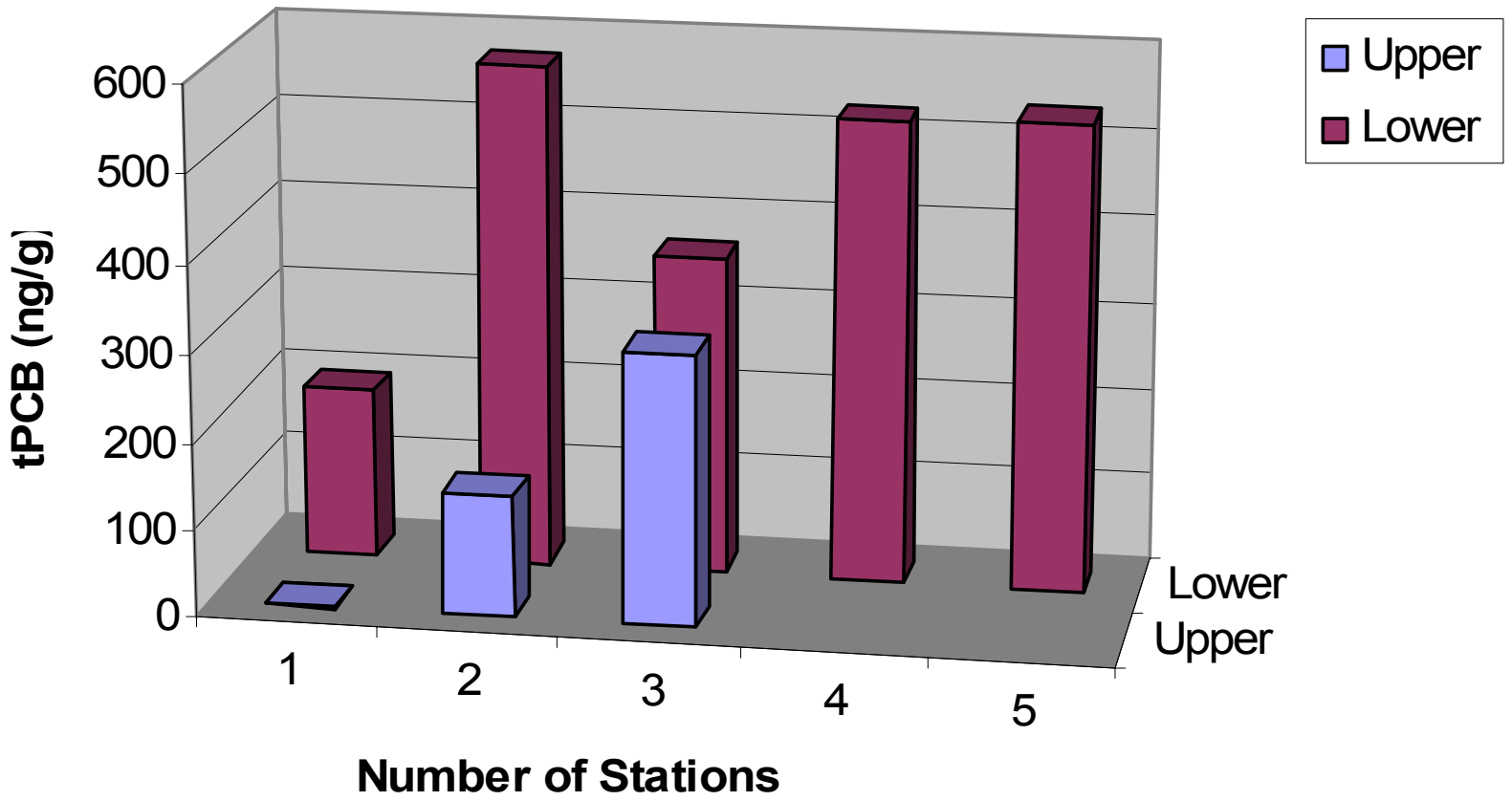
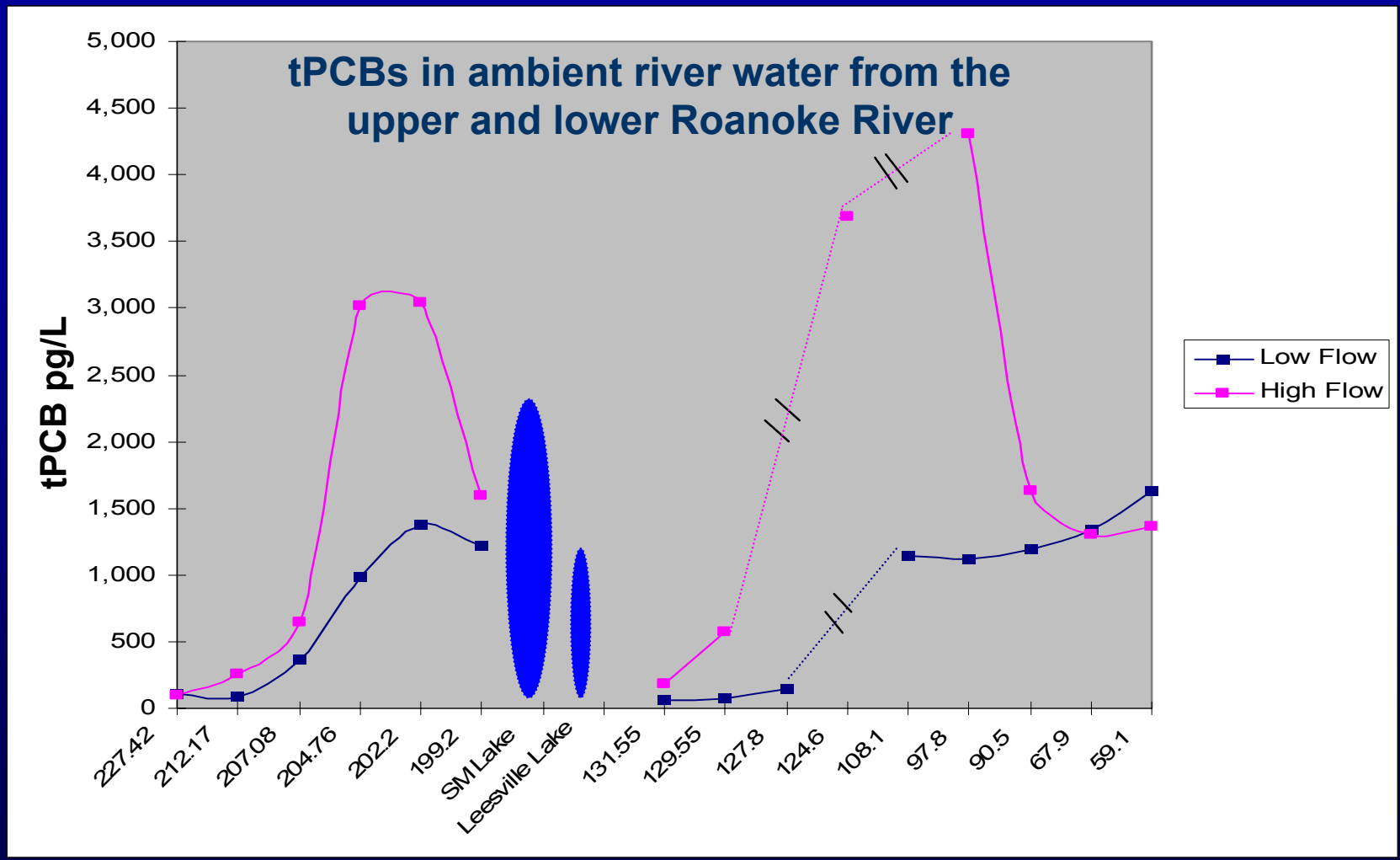
Average tPCB Fish Tissue Concentrations in the Upper and Lower Roanoke River (2006)



Justification for Two PCB Endpoints



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